ANNUAL RESEARCH REPORT
FY 2008
9 February 2009

1) Title:

The Demography of Northern Spotted Owls (*Strix occidentalis caurina*) on the Willamette National Forest, Oregon.

2) Principal Investigator and Organizations:

Principal Investigator: Dr. Robert Anthony (Demography-RWU 4203); Biologists: Dr. Steven Ackers (Project Leader), Rita Claremont, Chris Domschke, Matthew Schwartz, Alexis Smoluk, and Lance Wyss. Oregon Cooperative Fish and Wildlife Research Unit (OCFWRU), Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

3) Study Objectives:

a. Estimate site occupancy rates, sex and age composition, nesting success, reproductive success and fecundity of the population of northern spotted owls on the Willamette National Forest.

b. Develop and maintain a capture history matrix of marked spotted owls to estimate survivorship and recruitment from mark-recapture models.

c. Obtain the data and parameter estimates required for periodic meta-analyses of fecundity, survivorship and annual rate of population change across the range of the northern spotted owl.

d. Examine the relationships between the above demographic parameters and land use allocations designated under the Northwest Forest Plan (NWFP)(USDA and USDI 1994).

e. Collaborate with other researchers examining northern spotted owl ecology throughout the Pacific Northwest.

4) Potential Benefit or Utility of the Study:

Studying the population demography, habitat selection, foraging ecology, and diets of northern spotted owls will continue to increase our understanding of the factors affecting spotted owl populations. The demographic parameters estimated by this study will continue to be an important part of the meta-analyses of northern spotted owl populations throughout their range (Burnham et al. 1996, Franklin et al. 1999, Anthony et al. 2006). Our results support the validation and monitoring requirements of the NWFP (USDA and USDI 1994) and were an important part of the 2004 status review. Data from this study also have been used in analyses of

occupancy rates (Olson et al. 2005) and models to predict demographic rates from vegetative characteristics around nest sites (Olson et al. 2004). Our data continue to be used in new approaches to analyzing the effects of habitat, climate, and barred owl (*Strix varia*) presence on spotted owl demography.

5) Study Description and Survey Design:

Site occupancy, nesting and reproductive success, and fecundity were calculated through annual monitoring of a sample of northern spotted owl sites in the central Oregon Cascades. Color-banded spotted owls were identified at each site and their nesting and reproductive status were determined according to established protocols (Forsman 1995). Results were tabulated for the entire study area as well as for three NWFP land use allocations of late-successional reserves (LSR), adaptive management areas (AMA), and matrix. We were particularly interested in the productivity and survivorship of the northern spotted owls in the four LSRs on the study area as this land use allocation is intended to provide the habitat base for the recovery of the species.

Survivorship and annual rate of population change were calculated at five-year intervals within a mark-recapture framework. These results were used in the meta-analyses of the spotted owl populations throughout their range (Burnham et al. 1996, Franklin et al. 1999, Anthony et al. 2006).

We also located and monitored several spotted x barred owl hybrids which have increased in abundance in recent years. These results were presented separately. Unless otherwise indicated, the following discussion was pertinent only to our analyses of spotted owl demography.

6) Research Accomplishments (Demography) for FY 2008:

Site occupancy

Although all of the sites surveyed in 2007 (167 sites) were visited in 2008, surveys at 14 sites were delayed due to an exceptionally deep snow pack and did not meet the protocol minimum of three night visits to establish non-occupancy (Figure 1). Most of the inadequately surveyed sites were at high elevation and had a poor history of occupancy. Regardless, the percentages reported below are likely to be positively biased because several unoccupied sites are not included in the total. As in previous years, one site (Christy Flats) was not surveyed because of close proximity to two active spotted owl nests.

Simple occupancy (*i.e.*, sites with either a pair or a single owl) decreased by 11% while pair occupancy decreased by only 1% between 2007 and 2008 (Figure 1, Table 1). Most of the occupied sites in 2008 were occupied by pairs (76%) and substantially fewer were occupied by resident single owls (5%) or single owls with unknown residency status (19%)(Table 1). The percentage of sites with territorial single owls decreased by 2% (Table 1). The residency status of

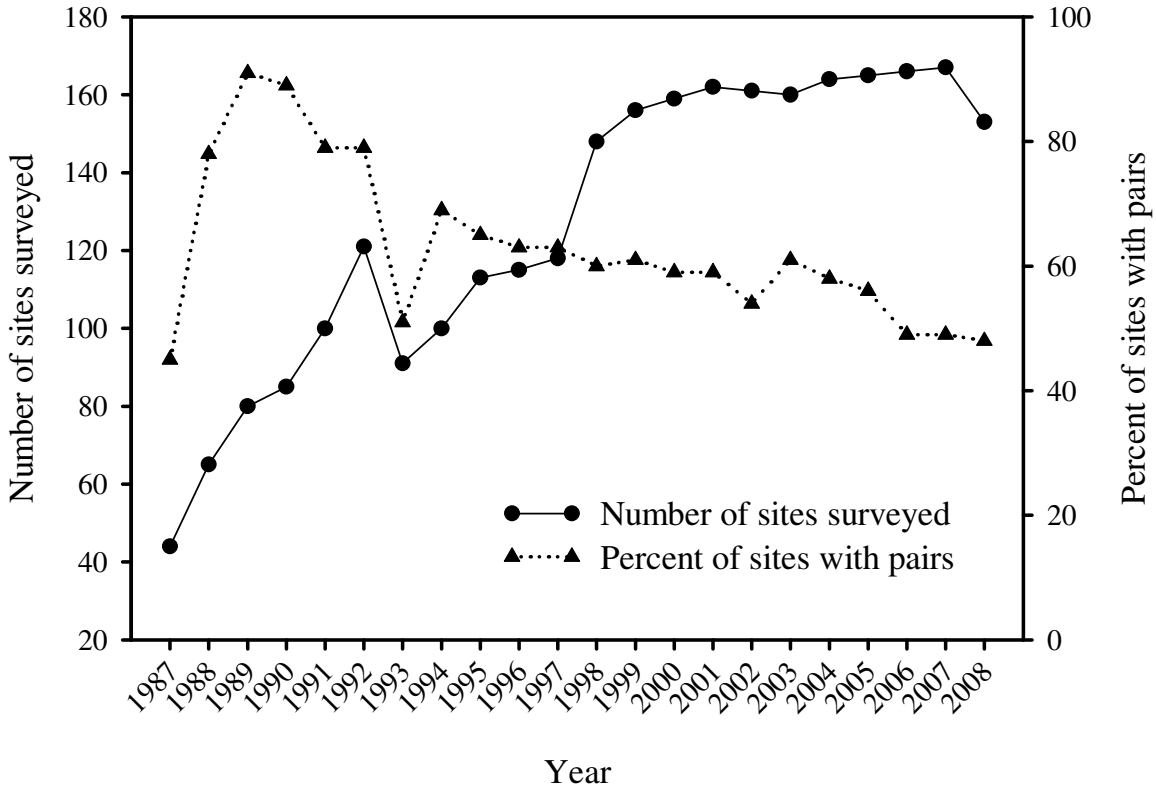

Figure 1. Number of sites surveyed for northern spotted owls and the percentage of those sites occupied by pairs in the central Cascades study area, Willamette National Forest, Oregon from 1987 through 2008.

either the male and/or the female was unknown for 5 (7%) of the pairs. The percentage of unoccupied sites was the highest since the initiation of the study (37%, Table 1).

The highest estimates of simple occupancy (62%) were in the LSR lands despite a decrease of 4% in 2008. Simple occupancy in the LSR allocation has been declining since 2000 when we began monitoring the current number of LSR sites. The greatest decrease in simple occupancy occurred in the AMA allocation (20%) while the matrix showed a 3% increase in simple occupancy (Table 2).

Although pair occupancy in the AMA allocation in 2008 increased by 1% (Figure 2), this represented a loss of one pair because three fewer sites could be classified as unoccupied by survey protocol (Table 2). Similarly, the percentage of sites occupied by pairs in the matrix increased by 3% even though the same number of pairs was located. Both the number of pairs and the percentage of sites occupied by pairs decreased in the LSR allocation. LSR sites continued to have lower levels of pair occupancy (40%) relative to matrix (64%) and AMA sites (48%, Figure 2). Pair occupancy decreased by four sites in the South Santiam LSR and five sites

Table 1. Occupancy and residency status of northern spotted owl sites (territories) surveyed on the central Cascades study area, Willamette National Forest, Oregon, 1987-2008.

Year	Sites surveyed [a]	Sites with pairs	Sites with single owls	Sites with residency unknown [b]	Occupied sites (%)	Unoccupied sites [c]	Sites with unknown occupancy [d]
1987	44	20	2	4	26 (59)	-	18
1988	65	51	2	1	54 (83)	-	11
1989	80	73	4	3	80 (100)	-	27
1990	85	76	0	3	79 (93)	6	27
1991	100	79	5	8	92 (92)	8	3
1992	121	96	4	14	114 (94)	7	28
1993	91	46	13	15	81 (89)	10	19
1994	100	69	7	22	98 (98)	2	19
1995	113	73	10	8	91 (80)	22	12
1996	115	73	11	6	90 (78)	25	5
1997	118	74	8	11	93 (79)	25	11
1998	148	89	7	18	114 (77)	34	18
1999	156	95	13	17	123 (78)	34	12
2000	159	94	8	27	129 (80)	32	0
2001	162	95	10	27	132 (81)	29	1
2002	161	87	11	29	127 (79)	33	1
2003	160	97	12	16	125 (78)	34	1
2004	164	95	6	24	125 (76)	38	1
2005	165	92	20	19	131 (74)	34	0
2006	166	81	13	23	117 (70)	49	0
2007	167	82	8	27	117 (70)	50	0
2008	153	73	5	18	96 (59)	56	14

[a] Occupancy and residency were determined by 1995 protocols (Forsman 1995).
[b] Residency status was undetermined at sites where responses were obtained from male and/or female owls but criteria for pair or resident single occupancy status were not met.
[c] Unoccupied sites were surveyed at least three times at night with no responses or where owls from a neighboring site were detected.
[d] Sites with fewer than 3 night visits.

Table 2. Occupancy and residency status of northern spotted owl sites by land-use allocation[a] on the central Cascades study area, Willamette National Forest, Oregon, 1997-2008.

Land use allocation [b]	Year	Sites surveyed	Sites with pairs	Sites with single owls	Sites with unknown social status	Occupied sites (%)	Unoccupied sites	Sites with unknown occupancy
Matrix	1997	42	28	3	0	31 (74)	10	1
	1998	41	25	2	4	31 (76)	10	0
	1999	43	26	3	2	31 (72)	12	0
	2000	37	25	2	4	31 (84)	6	0
	2001	37	26	3	5	34 (92)	3	0
	2002	37	22	2	7	31 (84)	6	0
	2003	37	26	2	2	30 (81)	6	1
	2004	36	25	1	5	31 (86)	5	0
	2005	38	25	1	4	30 (79)	7	0
	2006	38	22	1	4	27 (71)	10	0
	2007	38	23	1	1	25 (66)	13	0
	2008	36	23	0	2	25 (69)	11	2
AMA	1997	47	32	3	1	36 (77)	11	0
	1998	43	34	0	4	38 (88)	5	0
	1999	43	30	2	4	36 (84)	7	0
	2000	43	29	2	4	35 (81)	8	0
	2001	44	27	4	5	36 (82)	8	0
	2002	43	27	4	5	36 (84)	6	1
	2003	43	30	2	3	35 (81)	8	0
	2004	45	26	2	4	32 (71)	13	0
	2005	45	26	10	5	41 (91)	5	0

Land use allocation [b]	Year	Sites surveyed	Sites with pairs	Sites with single owls	Sites with unknown social status	Occupied sites (%)	Unoccupied sites	Sites with unknown occupancy
AMA (*cont.*)	2006	45	24	4	7	35 (78)	10	0
	2007	47	22	3	12	37 (79)	10	0
	2008	44	21	1	4	26 (59)	18	2
LSR	1997	27	8	2	8	18 (67)	7	2
	1998	65	28	4	8	40 (62)	16	9
	1999	64	35	7	9	51 (80)	12	1
	2000	72	35	3	18	56 (78)	16	0
	2001	75	37	3	17	57 (76)	17	1
	2002	75	34	5	15	54 (72)	21	0
	2003	75	36	8	12	56 (75)	19	0
	2004	77	41	2	14	57 (74)	19	1
	2005	76	39	9	7	55 (72)	21	0
	2006	77	31	8	10	49 (64)	28	0
	2007	76	34	4	12	50 (66)	26	0
	2008	68	27	4	11	42 (62)	25	9

[a] See the Northwest Forest Plan (USDA and USDI 1994) for a description of land use allocation forest management strategies.
[b] Sites with LUA designation of ▪Other•, ▪Private•, and ▪Wilderness• are not included here

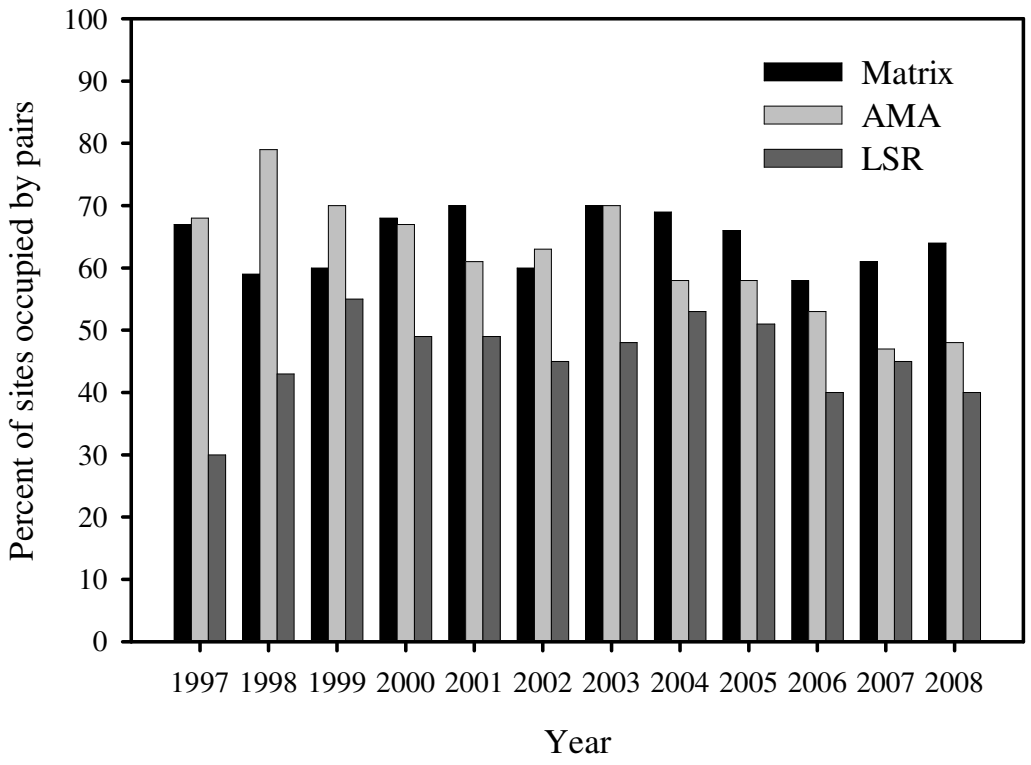

Figure 2. Percentage of sites occupied by pairs of northern spotted owls compared among land use allocations in the central Cascades study area, Willamette National Forest, Oregon from 1997 through 2008.

in the Fall Creek LSR in 2008. The same numbers of pairs were located in the Hagan and Horse Creek LSRs (Appendix I). Although pair occupancy in the LSRs has varied over time, no long-term trend was apparent.

Six additional sites were surveyed in other land use allocations such as research natural areas and wild and scenic river corridors. Two of these sites were occupied by pairs, two by a single owl of unknown residency status, and two were unoccupied.

Sex and age composition

At least 176 non-juvenile and 31 juvenile spotted owls were detected in 2008 (Table 3). The majority of the non-juvenile owls of known age were at least three years old (97%). Four spotted owls were identified as subadults: two two-year-old males, one two-year-old female, and one spotted owl of undetermined sex whose exact age was not determined. Of the owls that were not identified to age class (11%), most were detected as nocturnal auditory responses only and were

Table 3. Sex and age composition of northern spotted owls on the Central Cascades Study Area, Willamette National Forest, Oregon, 1987-2008.

Year	Adults (M, F)	Subadults [a] (M, F)	Age unknown (M, F)	Non-juveniles [b] (M, F)	Juveniles [c]
1987	53 (29, 24)	6 (3, 3)	15 (14, 1)	74 (46, 28)	12
1988	98 (49, 49)	13 (9, 4)	9 (4, 5)	120 (62, 58)	40
1989	135 (72, 63)	13 (7, 6)	14 (8, 6)	162 (87, 75)	27
1990	134 (72, 62)	9 (2, 7)	28 (17, 11)	171 (91, 80)	37
1991	152 (82, 70)	12 (6, 6)	44 (25, 19)	208 (113, 95)	30
1992	170 (88, 82)	8 (3, 5)	30 (17, 13)	208 (108, 100)	116
1993	122 (72, 50)	6 (4, 2)	23 (16, 7)	151 (92, 59)	0
1994	144 (77, 67)	6 (0, 6)	14 (8, 6)	164 (84, 79)	28
1995	151 (76, 75)	2 (2, 0)	19 (13, 6)	172 (91, 81)	22
1996	140 (71, 69)	8 (4, 4)	17 (13, 4)	165 (88, 77)	68
1997	139 (71, 68)	9 (5, 4)	21 (9, 12)	169 (85, 84)	24
1998	172 (86, 86)	8 (6, 2)	40 (27, 13)	220 (119, 101)	42
1999	169 (89, 80)	2 (2, 0)	56 (36, 20)	227 (127, 100)	21
2000	169 (85, 84)	6 (5, 1)	53 (36, 17)	228 (126, 102)	60

Year	Adults (M, F)	Subadults [a] (M, F)	Age unknown (M, F)	Non-juveniles [b] (M, F)	Juveniles [c]
2001	189 (98, 91)	7 (4, 3)	38 (25, 14)	234 (127, 107)	83
2002	168 (89, 79)	11 (4, 7)	46 (26, 20)	225 (119, 106)	67
2003	172 (93, 79)	18 (7, 11)	40 (21, 19)	230 (121, 109)	25
2004	187 (99, 88)	13 (7, 6)	29 (19, 10)	229 (125, 104)	105
2005	171 (92, 79)	11 (5, 6)	54 (33, 21)	236 (130, 106)	13
2006	149 (82, 67)	11 (6, 5)	37 (23, 14)	197 (111, 86)	20
2007	178 (90, 88)	2 (1, 1)	30 (24, 6)	210 (115, 95)	48
2008	154 (82, 72)	4 (2, 1, 1 Unk.)	18 (10, 8)	174 (93, 81)	31

[a] One- and two-year-old age classes combined.
[b] Adults and subadults combined.
[c] Includes the total number of young located from 1 April to 31 August, including pre- and post-fledging mortalities.

not relocated on the daytime follow-ups. All of the owls that were identified by reading their color bands (182) were assigned to an age class. A subadult of unknown sex was wearing a fledgling band but was not captured for positive identification.

The sex ratio among adults (three-year-olds and older) identified in 2008 was similar to past estimates (1.14:1 for 2008, 1.12:1 averaged over all previous years). Among subadults, the sex ratio was more skewed toward males in most years (1.47:1 averaged over all years) reflecting lower detectability of subadult females. However, small sample sizes in the subadult age class resulted in more annual variation in the sex ratios which ranged from 0:1 in 1994 to 2.25:1 in 1988. More subadult females than males were detected in only 6 of the past 20 years (e.g., 0.64:1 for 2003). The average sex ratio among unclassified non-juveniles was even more variable and heavily skewed toward males (mean = 2.30:1, range: 0.75:1 - 14:1). Most of these unclassified owls were detected only once at night and were never relocated for identification, which suggests that many of them did not hold territories. Gender differences in detection probabilities were

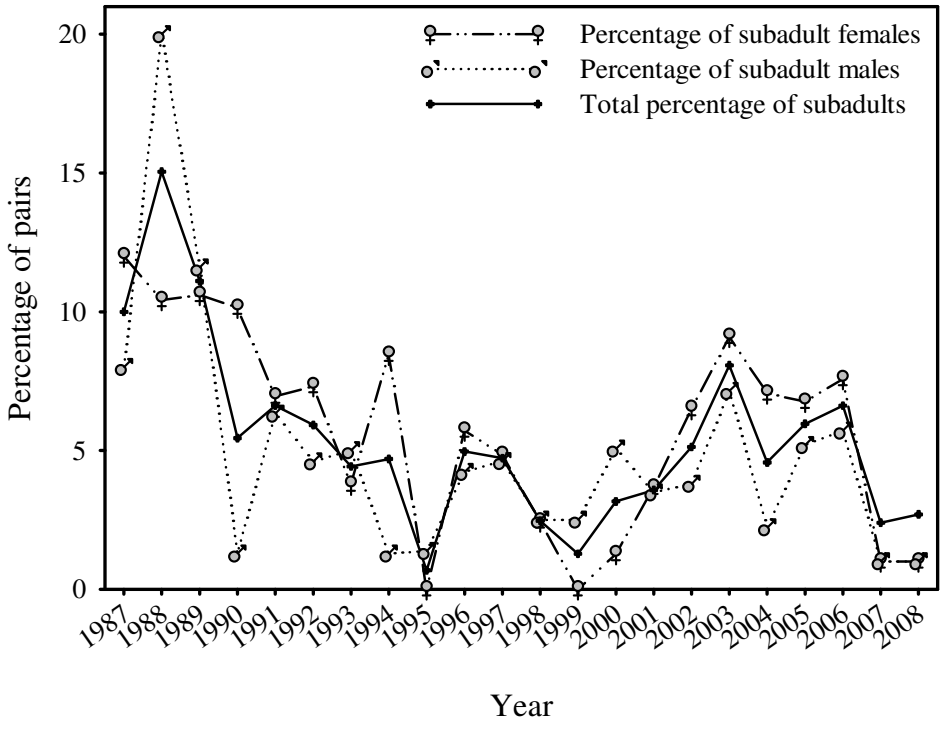

Figure 3. Percentage of pairs that included at least one subadult in the central Cascades study area, Willamette National Forest, Oregon from 1987 through 2008.

probably more extreme for non-territorial owls than for those defending territories.

Among paired owls, only one (1.4%) of the females was a subadult in 2008. Subadults have been paired much less frequently than adults in every year of the study. The percentage of pairs with at least one subadult has varied widely from a high of 15.1% in 1988 to a low of 0.68% in 1995. A "lag effect" of increased proportions of paired subadults 1 - 2 years following years of high productivity has been frequently observed (Figure 3). There does not appear to be a trend toward an increasing proportion of subadults in the population of territorial pairs.

Nest success

We were able to survey 38 spotted owl pairs prior to 1 June 2008 to determine nesting status according to protocol (Forsman 1995). The percentage of pairs that attempted to nest (55%) was greater than the average over all previous years (mean percent nesting/year = 48%, SE = 5.6). The percentage of nesting pairs that fledged at least one young was near this average (67% in 2008, mean percent successful/year = 68%, SE = 4.7). The estimates of nesting attempts from 2004 through 2008 were not consistent with the even-odd year pattern observed during the 1990s (Figure 4). One nesting pair failed prior to 1 June and an additional 7 pairs nested but did not

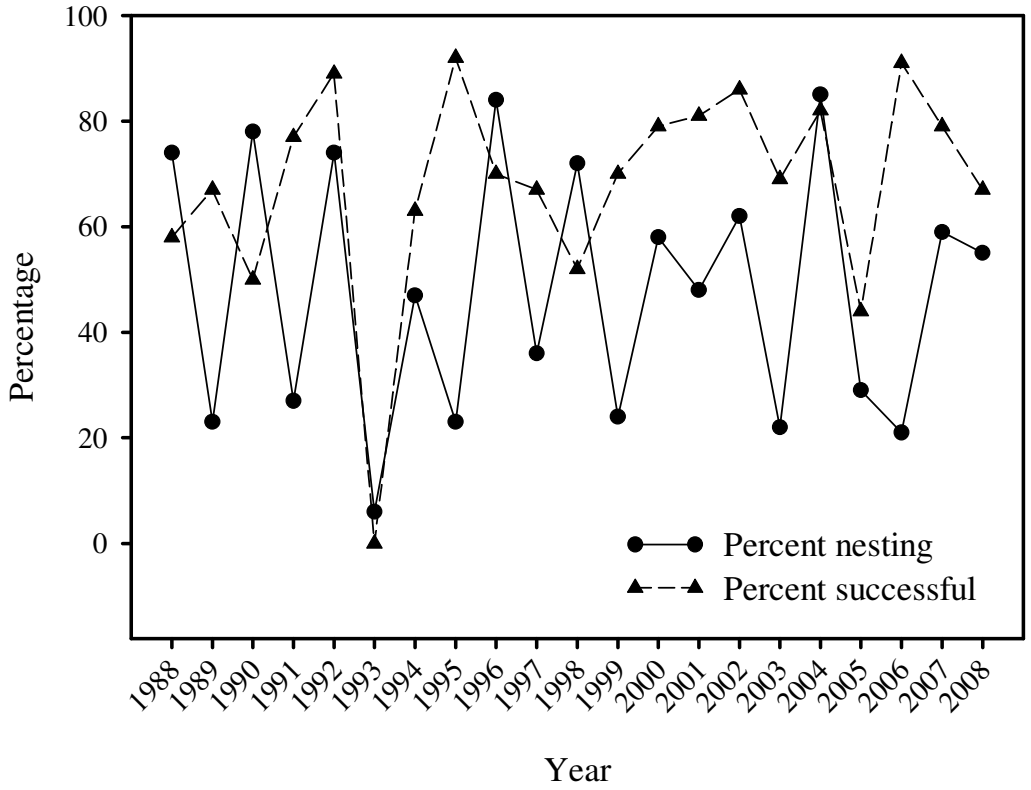

Figure 4. Percentage of pairs confirmed nesting prior to 1 June 2008 and the percentage of nesting pairs that fledged at least one young in the central Cascades study area, Willamette National Forest, Oregon from 1988 through 2008.

fledge any young. All of the nesting spotted owls that were identified were adults. One nesting female was not identified and could not be assigned to an age class.

Reproductive success

Sixty-three spotted owl pairs and one single female were checked for reproductive status prior to 31 August 2008 (Table 4, Figure 5). This includes the 38 pairs that were surveyed for nesting status as well as 25 additional pairs that were not located prior to 1 June or were located at high elevation sites that were not accessible before that date. Two pairs initially fledged two young but subsequent visits indicated that only one had survived.

The average number of young produced per successful pair (1.41 young/successful pair) was less than the average over all previous years of the study (mean young/successful pair/year = 1.6, SE = 0.05; Table 4). With the exception of 1993 when no young were fledged, there was little variation in the number of young produced by pairs that successfully nested. For all pairs surveyed for reproductive status, the average number of young produced per pair in 2008

Table 4. Summary of reproductive surveys for northern spotted owls in the Central Cascades Study Area, Willamette National Forest, Oregon from 1988 through 2008.

Year	Number of pairs checked [a]	Number (%) of pairs fledging young	Number of young fledged	Average number of young per successful pair	Average number of young per pair (all pairs)
1988	39	20 (51)	35	1.75	0.90
1989	49	10 (20)	17	1.70	0.35
1990	63	29 (46)	36	1.24	0.57
1991	58	16 (28)	30	1.88	0.52
1992	61	47 (77)	86	1.83	1.41
1993	50	0 (0)	0	0.0	0.0
1994	63	21 (33)	28	1.33	0.44
1995	73	13 (18)	22	1.69	0.30
1996	66	42 (64)	68	1.62	1.03
1997	62	15 (24)	24	1.60	0.39
1998	78	28 (36)	42	1.50	0.54
1999	75	11 (15)	21	1.91	0.28
2000	75	37 (49)	60	1.62	0.80
2001	87	48 (55)	81	1.69	0.93
2002	74	39 (53)	60	1.54	0.81
2003	75	14 (19)	25	1.79	0.33
2004	92	62 (67)	102	1.66	1.12
2005	67	12 (18)	13	1.08	0.19
2006	66	13 (20)	20	1.54	0.30
2007	70	31 (44)	48	1.55	0.69
2008	63	22 (35)	31	1.41	0.49

[a] Includes pairs that were given at least four mice on two or more occasions prior to 31 August.

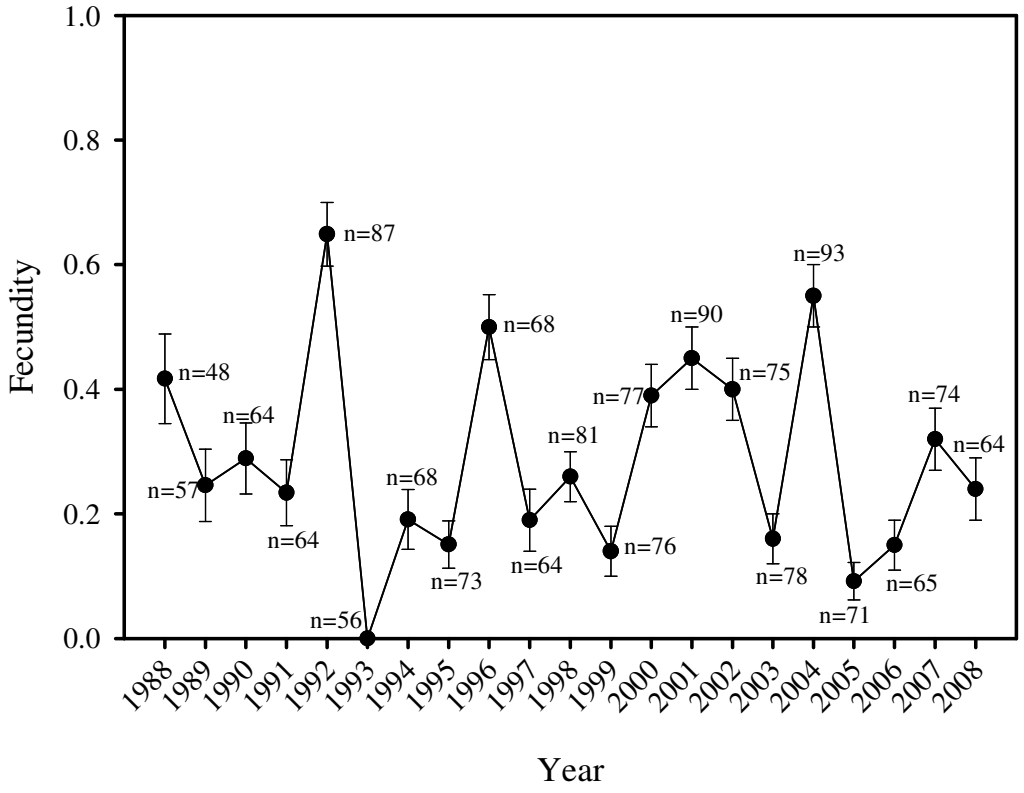

Figure 5. Annual fecundity estimates for the central Cascades study area, Willamette National Forest, Oregon from 1988 through 2008. Sample sizes indicate the numbers of paired or single females checked for reproductive status before 31 August each year.

(0.49 young/pair) was less than the average over previous years (mean number of young/pair/year = 0.58, SE = 0.07; Table 4).

Fecundity was calculated as the average number of female offspring per female checked for reproductive status twice before 31 August (Forsman 1995). The fecundity estimate for 2008 was 0.24 female young/adult female (SE = 0.05, Figure 5), which was slightly less than the average over previous years (mean fecundity/year = 0.29, SE = 0.04). Spotted owl productivity increased in the AMA allocation but decreased in the matrix and LSR lands in 2008 (Table 5). Productivity in the Fall Creek LSR dropped sharply to approximately half of the average number of young produced per pair for that reserve. Productivity in the other three LSRs remained negligible (Appendix 3).

Banding/re-observation

Forty spotted owls were banded in the study area and at four nearby wilderness sites in 2008: 27 fledglings and 13 adults (Table 6). From 1987 - 2008, 636 non-juveniles and 847 fledglings have been banded for a grand total of 1,483 banded spotted owls. Based on re-observations of

Table 5. Summary of reproductive success of northern spotted owls stratified by land use allocation on the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 through 2008.

Land use allocation [a]	Year	Number of pairs [b]	Number (%) of pairs fledging young	Number of young fledged	Average number of young per successful pair	Average number of young per pair (all pairs)	Mean fecundity (number of females)
Matrix	1997	22	5 (23)	8	1.60	0.36	0.17 (23)
	1998	22	12 (55)	18	1.50	0.82	0.39 (27)
	1999	23	2 (9)	3	1.50	0.13	0.07 (23)
	2000	24	10 (42)	17	1.70	0.71	0.34 (25)
	2001	26	10 (38)	17	1.70	0.65	0.31 (27)
	2002	18	9 (50)	14	1.56	0.78	0.39 (18)
	2003	22	2 (9)	3	1.50	0.14	0.07 (22)
	2004	25	20 (80)	33	1.65	1.32	0.66 (25)
	2005	21	3 (14)	3	1.00	0.14	0.07 (21)
	2006	20	6 (30)	10	1.67	0.50	0.25 (20)
	2007	20	10 (50)	15	1.50	0.75	0.36 (21)
	2008	20	6 (30)	9	1.50	0.45	0.23 (20)
AMA	1997	29	9 (31)	15	1.67	0.52	0.26 (29)
	1998	31	7 (23)	9	1.29	0.29	0.15 (31)
	1999	28	4 (14)	8	2.00	0.29	0.14 (29)
	2000	24	12 (50)	20	1.67	0.83	0.42 (24)
	2001	24	14 (58)	24	1.71	1.00	0.46 (26)
	2002	24	9 (38)	13	1.44	0.54	0.27 (24)
	2003	23	4 (17)	8	2.00	0.35	0.17 (23)

Land use allocation [a]	Year	Number of pairs [b]	Number (%) of pairs fledging young	Number of young fledged	Average number of young per successful pair	Average number of young per pair (all pairs)	Mean fecundity (number of females)
AMA (*cont.*)	2004	26	18 (69)	30	1.67	1.15	0.58 (26)
	2005	19	7 (37)	8	1.14	0.42	0.19 (21)
	2006	20	5 (25)	8	1.60	0.40	0.20 (20)
	2007	16	4 (25)	6	1.50	0.38	0.17 (17)
	2008	17	10 (27)	15	1.50	0.88	0.44 (17)
LSR [c]	1997	5	0 (0)	0	0.00	0.00	0.00 (6)
	1998	21	7 (33)	12	1.71	0.57	0.26 (23)
	1999	20	5 (25)	10	2.00	0.50	0.25 (20)
	2000	23	14 (61)	22	1.57	0.96	0.46 (24)
	2001	33	22 (67)	37	1.68	1.12	0.56 (33)
	2002	28	19 (68)	31	1.63	1.11	0.53 (29)
	2003	26	5 (19)	9	1.80	0.35	0.16 (29)
	2004	38	22 (56)	34	1.55	0.89	0.44 (39)
	2005	26	2 (8)	2	1.00	0.08	0.04 (28)
	2006	22	2 (9)	2	1.00	0.09	0.04 (22)
	2007	32	15 (47)	23	1.53	0.72	0.35 (33)
	2008	23	6 (26)	7	1.17	0.30	0.15 (24)

[a] Sites with LUA designation “Other” not reported.
[b] Includes only pairs that were given at least 4 mice on two or more occasions prior to 31 August.
[c] The LSR estimates computed for 1998 - 2004 include the Fall Creek LSR which was not surveyed in 1997.

Table 6. Numbers of new spotted owls banded, re-sighted, and recaptured in the central Cascades study area and in nearby wilderness sites in the Willamette National Forest, Oregon during 2008.

	New owls banded			Owls re-sighted			Owls recaptured		
Age Class	Males	Females	Unk.	Males	Females	Unk.	Males	Females	Unk.
Adult	7	6	0	69	61	0	5	5	0
Subadult	0	0	0	1	1	0	0	0	0
Juvenile	-	-	27	-	-	-	-	-	-

banded non-juvenile owls in 2008, the minimum average age for males on the study area was 8.7 years (SE = 0.56) and 8.1 years (SE = 0.56) for females. The oldest owl located in 2008 was a male banded as an adult in 1989 which was at least 22 years old. The oldest female was 20 years old; she also was banded as a subadult in 1989.

There were 19 movements of spotted owls between site centers within the study area and one movement from outside the study area in 2008. Nineteen adult owls and one subadult owl were recaptured or re-sighted at new locations within our study area. Six owls originally banded as fledglings were recaptured and fitted with adult bands; two were originally banded in 2004 and one each was banded in 2006, 2005, 2003, and 2000. One of these fledglings was banded at least 41 km northwest of the study area on the Salem district of the BLM. Since the initiation of the study in 1987, 136 (16%) of the fledglings banded on our study area have been recaptured and fitted with adult bands. Twenty-five (18%) of the banded fledglings were recaptured as one-year-olds, 36 (26%) as two-year-olds, and 75 (55%) as adults. Most recaptured fledglings are recaptured two years after banding. Among those recaptured as adults, most are recaptured after 3 or 4 years. The longest period of time between initial banding and recapture was 11 years (Figure 6).

Wilderness surveys

Six sites located in the Three Sisters and Mount Washington Wilderness Areas near the study area boundary had been surveyed on an irregular basis since 1989. Since 1998, these sites have been surveyed annually. Pair occupancy was initially high in the wilderness boundary sites but has declined between 2000 and 2004. In 2005, pair occupancy increased to 5 of the 6 sites but no young were produced. Pair occupancy returned to the previous level in 2006 but only one pair produced young. In 2007, pairs were located at three sites and all three pairs successfully fledged at least one offspring. Only two pairs were located in 2008 and no young were produced (Table 7).

Thirty-five sites located in the Three Sisters and Mount Washington Wilderness Areas were surveyed irregularly from 1987 through 1999. Twenty-eight owls have been banded at these sites, although only one male owl was later relocated on the study area. One male and one female owl banded on the study area were re-sighted in the wilderness, but survey effort at these wilderness sites was inadequate to estimate dispersal across the wilderness boundary.

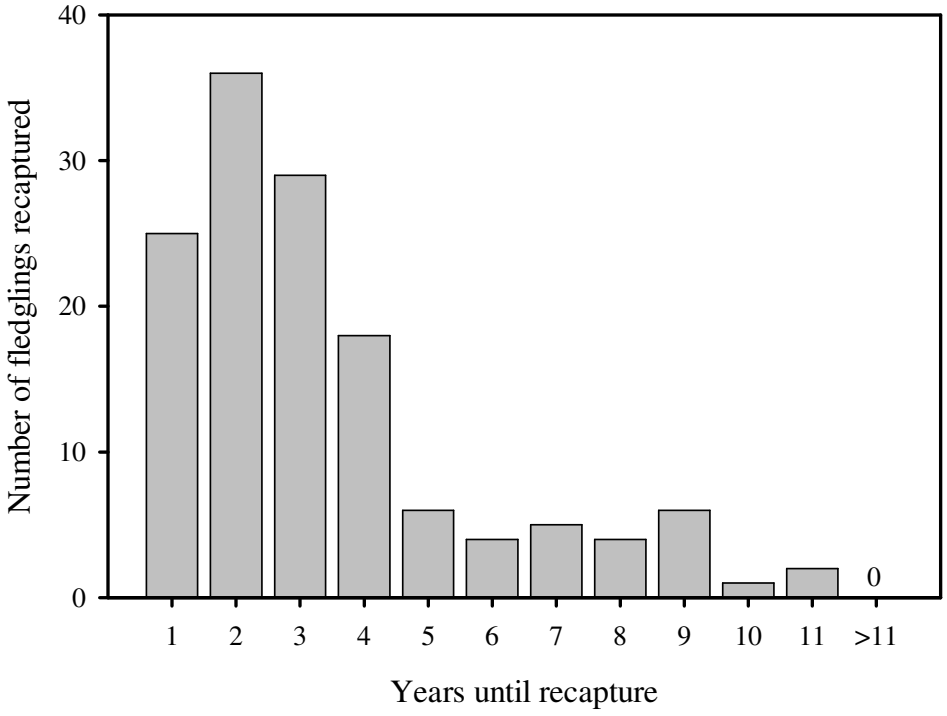

Figure 6. Years until the first recapture of northern spotted owls banded as fledglings in the central Cascades study area, Willamette National Forest, Oregon from 1987 through 2008.

Barred owl occupancy

The overall percentage of sites with at least one barred owl remained relatively constant from 2006 through 2008 (Figure 7). Through 2003, an increase was primarily observed in the response rate of single barred owls while the rate of barred owl pair responses fluctuated at a low level. Since 2003, responses by pairs of barred owls have been increasing at nearly the same rate as single barred owl responses. The percentage of sites with barred owl pairs was higher at 14% in 2008. Barred owls were detected at two sites with no previous history of barred owl detections.

Hybridization with barred owls

Since 1999, we have located as many as 13 non-juvenile spotted-barred owl hybrids at 15 different sites (Appendix 5). In addition, we have documented one instance of a spotted-barred pair producing 2 hybrid young and five instances of hybrid-barred pairs producing one or two backcross young (a total of 8 backcross young). Only two of these hybrids were relocated in 2008: a hybrid female remained paired with a spotted owl male and a resident single male hybrid was located in its historic territory.

Only two of the hybrids located since 1999 were found outside of an LSR. A hybrid female was

Table 7. Wilderness boundary sites surveyed concurrently with the demographic study in the central Cascades study area, Willamette National Forest, Oregon from 1997 through 2008.

Year	Sites surveyed [a]	Sites with pairs	Number of pairs producing young	Number of young fledged
1997	5	4	1	2
1998	5	5	1	1
1999	5	5	0	0
2000	5	3	0	0
2001	5	4	0	0
2002	5	2	0	0
2003	6[b]	3	0	0
2004	6	2	0	0
2005	6	5	0	0
2006	6	3	1	2
2007	6	3	3	4
2008	5	2	0	0

[a] Includes only sites that were surveyed at least 3 times at night.
[b] One site previously within an LSR has been re-assigned to the wilderness based on the 3 most recent owl locations.

found near a historic spotted owl nest site within a Wild and Scenic River corridor along the McKenzie River in 2004, and another hybrid female was located near a site center in the matrix allocation. Eleven of the other 12 hybrid detections were in the Fall Creek LSR; the other hybrid was located in the Horse Creek LSR. Two of the hybrids immigrated over 100 km from their initial banding locations in the Klamath and Roseburg study areas to the Fall Creek LSR.

7. Discussion

Occupancy

Simple occupancy across all land use allocations decreased by 1-4% annually from 2000 through 2006. Although simple occupancy remained stable between 2006 and 2007, there was a decrease in simple occupancy of 11% between 2007 and 2008. This result should be interpreted with caution because 14 sites were not surveyed for a third time at night to confirm non-

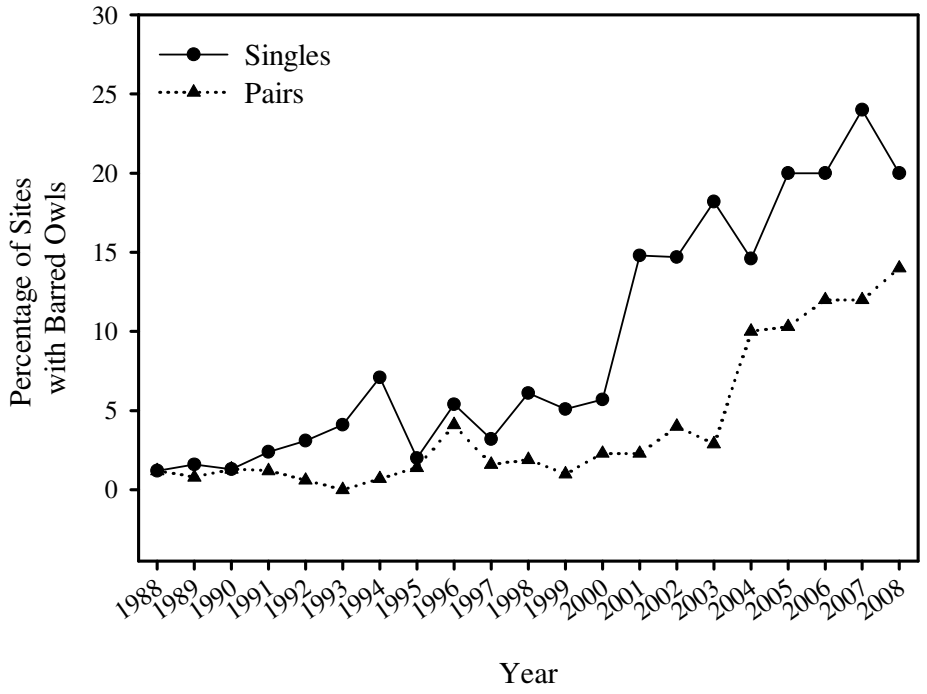

Figure 7. Percentage of sites where incidental detections of single and pairs of barred owls (*Strix varia*) have occurred while surveying for northern spotted owls in the central Cascades study area, Willamette National Forest, Oregon from 1988 through 2008.

occupancy in 2008 (Table 1). Survey effort during the last 4 weeks of the field season was directed toward identifying spotted owls at occupied sites, confirming reproductive status of owls identified earlier in the season and ensuring that all fledglings had been banded. The 14 sites for which we did not meet protocol requirements for non-occupancy had been surveyed twice with no spotted owl responses. If we assume that these sites were not occupied, then simple occupancy was 57%; if all were occupied, then simple occupancy was 66%. In either case, simple occupancy for the entire study area declined by at least 4% and possibly by as much as 13%.

Among the three primary land use allocations considered here, simple occupancy has varied over time but long-term trends are not obvious. Taking into consideration the sites that were not surveyed at night for a third time ranges of possible estimates were calculated for each land use allocation as above:

Matrix – 66% - 71%
AMA – 55% - 62%
LSR – 55% - 74%

The greatest decline has occurred in the matrix allocation where the percentage of occupied sites decreased from 92% in 2001 to 66% in 2007. In 2008, this estimate remained stable or may have increased by as much as 5%. Simple occupancy in the AMA allocation dropped sharply in just

one year between 2005 and 2006 and by at least 17% between 2007 and 2008. A somewhat greater but more gradual decline in simple occupancy occurred in the LSR allocation between 1999 and 2005 (1.3% per year on average). In 2006, occupancy of LSR sites decreased by 8% and has remained at approximately the same level since. Until this year, simple occupancy had been lowest in the LSR allocation.

Decreases in simple occupancy may be an indication that both the territorial and non-territorial segments of the spotted owl population were declining, which is consistent with the annual rate of population change recently reported for this study area (Anthony et al. 2006).

The initial increase in pair occupancy from 1987 to 1989 is probably related to increased survey effectiveness as site centers were located. Subsequently, pair occupancy decreased an average of 2.5% per year from 1989 through 2007, and this decline has not been consistent from year to year. From 1989 to 1998, pair occupancy decreased 3.4% per year on average then declined an average of 0.8% annually through 2005. The greatest decline since 1998 occurred between 2005 and 2006 when pair occupancy decreased by 7%. The consistency of the pair occupancy estimates from 2006 to 2008 suggests that the decrease after 2005 reflects a decrease in the breeding population and is not the result of variation in probability of detecting pairs (Figure 1). The lack of night surveys discussed above did not affect the 2008 estimate of pair occupancy because survey effort was concentrated on sites where spotted owls had been detected earlier in the season or in past years.

All three land use allocations had declines in pair occupancy for 3 consecutive years beginning in 2004 with the greatest decreases observed in 2006. Although the matrix and LSR allocations had increases in pair occupancy in 2007, the AMA allocation continued to decline. Pair occupancy among the LSR sites remains lower than in the AMA and matrix sites despite a 5% increase in 2007 (Figure 2). The Fall Creek and South Santiam LSRs lost 5 and 4 pairs respectively in 2008. For the first time since we began surveying all of the Fall Creek LSR, the number of pairs dropped below twenty. Changes in occupancy in the LSR allocation are particularly pertinent to the effectiveness of the Northwest Forest Plan, as these areas were intended to provide the habitat necessary to bring about the recovery of the northern spotted owl. Our results indicate that not all LSRs are equally capable of supporting breeding pairs of spotted owls. At the present time, the Hagan, Horse Creek, and South Santiam LSRs do not support an adequate number of pairs of spotted owls to compensate for losses in areas where timber harvest may occur. Continued losses of pairs of spotted owls in the Fall Creek LSR may render that area ineffective in the future as well.

In assessing the rate of pair occupancy, it is important to evaluate the potential effect of nesting status on the detectability of pairs. Pairs that were nesting generally were easier to locate. Paired females often were found only if the male delivered a mouse to her. In years when relatively few pairs attempted to nest, many single males may in fact have been paired but did not deliver mice to a female. Pair occupancy was either unaffected or changed in the opposite direction in response to changes in nesting attempts in 14 of the past 20 intervals between years. Increased survey effort in low nesting years may explain this apparent contradiction. Several visits are often necessary to locate and identify non-nesting females. The higher survey effort required to locate non-nesting pairs was not reflected in the final determination of site occupancy.

Annual variation in adult sex ratios also was affected by changes in relative detectability between the males and females due to annual variation in the number of nesting attempts. In general, females were less responsive in years when few pairs nested than in years when most pairs nested. Fewer females therefore were detected in years with fewer nesting attempts.

Productivity

Our primary measure of productivity was fecundity which was estimated as the average number of female young produced by all adult and subadult female owls. Fecundity was affected by the proportion of females that were paired, variation in the numbers of pairs that nest, variation in nest success, and variation in the number of young fledged by successful pairs. Environmental conditions may affect spotted owl productivity at all of these levels but it was evident that the rates of nesting attempts and nest failures were the primary factors that affected productivity in spotted owls. Relatively few females were confirmed to be single (95% CI: 2.6 – 11.4%). Among those females that were paired and successfully fledged at least one young, there was little variation in the number of young produced (CV = 0.13). The percentage of pairs that attempted to nest was more variable (CV = 0.51) as was the percentage of nesting attempts that are successful (CV = 0.3).

A biannual pattern in nesting attempts was observed from 1988 through 2005. This pattern has been broken twice: once in 2000 through 2002 when above average nesting attempts were recorded three years in a row and again in 2005 and 2006 when below average nesting attempts were recorded for two consecutive years. The proportion of pairs attempting to nest increased to just above average in 2007 then declined to slightly below average in 2008. Climatic factors, particularly average daily temperature and amount of precipitation in the late winter and early spring, have been suggested as potential causal mechanisms creating this pattern in northern California (Franklin et al. 2000). Pairs of spotted owls in the central Cascades of Oregon seem more likely to attempt to nest when temperatures are warm and precipitation is lower than in years when late season storms occur during the early stages of nesting. It is likely that milder conditions during the winters of 2000 through 2002 and relatively wetter and colder conditions during February and March of 2006 caused the deviations from the previous biannual pattern.

Although the percentage of pairs that attempted to nest declined slightly in 2008, we expected much fewer nesting attempts given the exceptionally high snowfall and low temperatures in the late winter and early spring of 2008. Precipitation in the form of snow may have less effect on nesting attempts than rain for at least two reasons. Falling snow may not mask the sounds of rodent movements as does rain (Franklin et al. 2000) or spotted owls may be better able to stay dry and avoid cold-induced stress in snow than in rain.

Nest success increased every year from 1998 to 2003 when we observed a decline in both nest success and in the percentage of pairs attempting to nest. After increasing to nearly the level of success observed in 1996, nest success in 2005 was lowest since 1993 when none of the nesting pairs were successful. Although few pairs attempted nesting in 2006, most of them fledged at least one young. Nest success decreased by 12% in 2007 and again in 2008 but this decline was offset by the greater number of pairs that attempted to nest. The number of young fledged by a

successful pair may be affected by climatic conditions particularly when the young are less well developed. Six post-fledging mortalities were confirmed in 2008. Five of these occurred during a week of cold temperatures and heavy rain in early June shortly after the young left the nest. Predation also may affect productivity both before and after fledging. However, direct observations or evidence of predation have been rare making it difficult to assess the magnitude of this effect. Barred owls affect spotted owl productivity through their effect on site occupancy by pairs of spotted owls (Olson et al. 2005), and through aggressive interactions with nesting pairs of spotted owls.

Management considerations

From 2000 to 2004 and in 2007, the largest numbers of young were produced in the LSR allocation (Table 5). In 2005, 2006, and 2008 productivity in the LSRs was lower than in the matrix and AMA allocations. Most of the young produced in the LSR allocation have been from the Fall Creek LSR. Very few young have been produced in the Horse Creek and South Santiam LSRs, and young were rarely produced in the Hagan LSR (Appendix 4). The wide fluctuations in productivity in the Fall Creek LSR and the relatively low numbers of young produced since 2005 suggest that this area may not be a reliable source of recruits in the future. The most likely reason for this has been the relatively high numbers of barred owls in the Fall Creek LSR. Since 2000, an average of 40% of all barred owl detections has been in the Fall Creek LSR (range: 27% - 44%). In most years, there has been nearly as many barred owls as have been detected in the matrix and AMA allocations combined (average percentage of barred owl detections = 43%, range: 33% - 61%).

Although the matrix and AMA allocations are subject to timber harvest, they still contain many productive spotted owl pairs that could make substantial contributions to population recovery. This underscores the importance of monitoring and protecting pairs of spotted owls outside of existing reserves. Given that timber harvest has resumed in the matrix and AMA allocations, it will be critical to continue keeping management agencies informed of the most recent locations of these productive pairs.

Two wildfires occurred on the study area in 2003. The Clark fire included three sites in the Slick Creek and Bedrock Creek watersheds in the Fall Creek LSR. This fire seems to have had little effect on site occupancy or productivity in this area. The Jones Creek (1013) spotted owl site was occupied by a pair from 2000 through 2002 that produced two young prior to the fire. From 2004 through 2006 this pair was still present and produced one young. In 2007 and 2008, Jones Creek was occupied by a non-nesting spotted-hybrid owl pair. West Slick Creek (4549) contained two nest trees, although one was used by a spotted-barred owl pair in 2001. This site remained unoccupied by spotted owls since the fire until 2006 when a subadult female was located with the male last seen in 2003 just before the fire. This site is no longer occupied by a pair and no young have been produced since the fire. North Slick Creek (4420) had not been occupied by a pair until after the fire and this pair fledged 2 young. This was the first documented reproduction in this site since 1996.

The B & B complex fire began late in the field season of 2003 and included only one site center (Lost Lake, MSNO 0815). This site contained four nest trees at elevations above 4,000 ft and has

been occupied by a pair in 13 of the 15 years that we have monitored the site. We located the historic pair near two of the previous nest trees in both 2004 and 2005. We detected an unidentified female during one night visit in late July of 2006. This site has been unoccupied since 2007 and the male from this site was relocated east of Carmen Reservoir approximately 7.5 miles south of Lost Lake in 2007. This fire may have negatively impacted the pair, although the effect of the fire was confounded by a pair of nesting great horned owls (*Bubo virginianus*) that were present and approximately 200 - 300 m from the historic spotted owl nest trees in 2006.

Current and future plans for timber harvest will provide an opportunity to evaluate the effects of different harvest strategies on spotted owl site occupancy and demography. Plans are currently underway for a large scale commercial thinning project in the Blue River watershed in the central Cascades AMA. This area contains several of the most productive pairs on the study area so it is critical that units are planned to minimize impacts on these pairs. Site- and year-specific data will be required to adequately assess the long-term effects of these actions. We continue to keep the Forest Service biologists informed about the most recent locations of the spotted owls in these areas.

Spotted owl - barred owl relationships

Barred owls have become increasingly abundant in the study area. Several pairs of spotted owls have been either excluded from suitable habitat or are inhibited from responding to our surveys as a result of barred owl presence. The effect of barred owls on spotted owl populations in the Oregon Cascades has been shown to negatively influence the probability of detecting spotted owls as well as the probability of a pair of spotted owls re-colonizing an abandoned site (Olson et al. 2005). The frequency of barred owl pair detections was highest in 2008 although the percentage of sites containing a single barred owl again decreased somewhat. Occupancy of sites by pairs of barred owls was probably underestimated because we rarely located barred owls following nocturnal detections of single barred owls. The effect of barred owls on survival, productivity and recruitment was investigated throughout the range of the northern spotted owl during the recent meta-analysis in January 2009, and these results will be available during summer 2009.

Spotted - barred owl hybrids have been located at 15 sites since 1999 (Appendix 5). Hybrid males were paired with barred owl females in 4 of 8 pairs. A male spotted owl was observed paired with a barred owl in one case and with a hybrid owl in a two cases. One case of a barred owl male paired with a hybrid female also has been observed. Reproduction has been observed between a male hybrid and a female barred owl (a total of 8 young fledged by 2 pairs) and between a male spotted owl and a female barred owl (2 young fledged). To date, female spotted owls have not been observed pairing with male barred or hybrid owls in this study area. This is consistent with other studies that indicated that female spotted owls rarely mate with barred or hybrid owls (Kelly 2001, Haig et al. 2004). We typically have not been following up on detections of single male barred owls, so we do not know how frequently female hybrid or spotted owls also are present.

8. Problems encountered:

An exceptionally deep snow pack and an associated increase in the number of downed trees blocking Forest Service roads combined to greatly hinder our access to nearly all of our sites in 2008. Despite the efforts of Forest Service personnel to clear the roads, we spent several days clearing the roads rather than conducting site visits. Field crews utilized snowmobiles, cross-country skis and snowshoes to access sites, but all of these methods required considerably more time than driving. We attempted to minimize the effect on data quality by placing a higher priority on locating missing banded owls and confirming reproductive status than on confirming non-occupancy at sites that have not been occupied for several years. Unfortunately, the end result was that 14 fewer sites were confirmed unoccupied than in 2007.

Although survey effort was the same for all three land allocations, more difficult access in the LSRs decreased detection probabilities by an unknown magnitude. Many of the secondary roads in the LSRs are no longer maintained and several have been decommissioned making portions of these sites difficult to survey effectively. More road closures occurred in 2008 and that is expected to continue through 2009 as well.

The Horse Creek and South Santiam LSRs include most of our high elevation sites where more snow remains longer into the spring which delays the first surveys until June when many spotted owls may have already nested and failed. This year, the highest sites were not accessible until July. As a result, the nesting and reproductive status of more owls remained unresolved in these LSR sites than in the matrix or AMA sites. Deeper and a more persistent snow pack also may influence the productivity of spotted owls in these LSRs.

9. Acknowledgments:

Several people from the Willamette National Forest contributed both information and equipment that made this study possible. Forest Service biologists Ruby Seitz, Penny Harris, and Shane Kamrath (McKenzie River Ranger District), Tiffany Young (Sweet Home Ranger District), and Dick Davis (Lowell Ranger District) regularly consult with us regarding management activities near the owl sites and have provided valuable information regarding the history of several sites. Shari Johnson (Pacific Northwest Forestry Sciences Laboratory), Cameron Bergen (Oregon State University) and the staff of the H. J. Andrews Experimental Forest provided housing and office facilities. Financial support was provided by the U. S. Forest Service and the Portland Field Office of the U. S. Fish and Wildlife Service. We also thank Steve Adey for his continued service to the project as a weekend volunteer.

10. Research plans for FY 2009:

a) Contribute mark-recapture and monitoring data for the next regional meta-analysis of spotted owl population demography scheduled for January 2009.

b) Continue the demographic study of the northern spotted owl population in the central Cascades of Oregon.

c) Continue comparing the demography of spotted owls among the matrix, AMA, and LSR land use allocations.

d) Increase efforts to locate, band, and obtain blood samples from spotted/barred owl hybrids.

e) Continue the analysis of spotted owl diet composition and update the prey database to be compatible with other studies.

f) Cooperate with the staff of the Middle Fork Ranger District in developing priorities for proposed management in the Fall Creek LSR.

g) Cooperate with the staff of the McKenzie River Ranger District in planning pre-commercial and commercial thinning operations in the Blue River watershed.

11. <u>Publications and technology transfer completed in FY 2008</u>:

Presentations

a) S. Ackers attended a meeting of Forest Service personnel to discuss plans for pre-commercial and commercial thinning operations in the Blue River watershed (January 2008).

b) S. Ackers took several USFWS personnel on a field trip to an active spotted owl site and discussed the implications of recent findings on the Recovery Plan for the Northern Spotted Owl (June 2008).

c) S. Ackers presented basic spotted owl ecology, the history of the spotted owl issue and recent demography results to an environmental science class visiting the H. J. Andrews Experimental Forest from Willamette University (August 2008).

d) S. Ackers presented a poster entitled "Northern Spotted Owl Demographics in the Central Oregon Cascades" for the 60th anniversary of the H. J. Andrews Experimental Forest.

Technology transfer.

a) Project personnel coordinated spotted owl surveys with the district biologists of the Willamette National Forest and continued to provide information on spotted owl locations and demographics for their management needs.

b) S. Ackers provided data to Matthew Johnson, a post-doctoral researcher studying the causal mechanisms influencing adult spotted owl dispersal.

c) S. Ackers provided data on occupancy and productivity of sites within 1.6 km of

BLM and private land to the Eugene BLM, Westside Ecological (under contract with the Oregon Department of Forestry), and Weyerhaeuser Inc.

d) S. Ackers attended monthly H. J. Andrews staff meetings at the H. J. Andrews Experimental Forest.

12. Duration of the study:

This study was initiated in FY 1987 and is part of the long-term monitoring plan for the northern spotted owl under the Northwest Forest Plan.

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Appendix 1. Occupancy [a] and reproductive [b] status of northern spotted owls in the four late-successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 2003 through 2008. Data from prior years are available upon request.

		2003		2004		2005		2006		2007		2008	
LSR	MSNO [c]	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.
Fall Creek	2462	-	-	SU	-	NR	-	P	0	P	1	P	0
	2444	-	-	P [d]	0	Unoccupied		P [d]	0	P	0	SU	-
	2463	P	N	P	2	RM	-	Unoccupied		SU	-	P	0
	0124	RF	-	P	N	P	F	P	N	P	1	P	0
	1012 [d]	P	F	A	2	P	Unk.	SU	-	RM	-	SD	-
	1013 [d]	RM	-	P	1	P	0	P	N	P [d]	0	P [d]	0
	1015 [d]	Unoccupied		SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	1016 [d]	P	N	P	0	P	F	SU	-	PU	Unk.	Unoccupied	
	1017	Unoccupied		SU	-	SU	-	SU	-	Unoccupied		Unoccupied	
	1018	RM	-	A	Unk.	P	0	P	N	P	0	RF	0
	1019	SU	-	SU	-	SU	-	Unoccupied		SU	-	NR	-
	1020	P	N	P	2	P	N	P	N	P	1	P	0
	1021	P	N	P	2	P	Unk.	P	N	P	0	P	0
	1022 [i]	P	N	P	2	RF	N	RM	-	P	0	P	0
	1022 [i]	-	-	-	-	-	-	-	-	-	-	P	1
	1028	SU	-	NR	-	SU	-	Unoccupied		Unoccupied		Unoccupied	
	1029	P	N	P	2	P	N	PU	Unk.	P	2	P	0
	1031 [d]	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied		NR	-
	1032	RM	-	PU	0	P	F	P	N	P	0	P	0
	1043	SU	-	Unoccupied		Unoccupied		Unoccupied		SU	-	Unoccupied	

LSR	MSNO [c]	2003 Occ.	2003 Repro.	2004 Occ.	2004 Repro.	2005 Occ.	2005 Repro.	2006 Occ.	2006 Repro.	2007 Occ.	2007 Repro.	2008 Occ.	2008 Repro.
Fall Creek	1101	SU	-	Unoccupied		Unoccupied		SU	-	Unoccupied		NR	-
	1102	P	N	P	2	P	Unk.	P	N	P	2	P	1
	2807	P	N	P	1	A	Unk.	P	N	P	1	P	0
	2808	P	Unk.	P	2	P	0	P	N	P	2	P	1
	2817	RM	-	P	2	P	N	A	N	P	1	P	2
	2826	PU	Unk.	PU	N	P	N	RM	-	P	0	SU	-
	2858 [f]	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2861 [d]	Unoccupied		SU	-	Unoccupied		Unoccupied		SU	-	SU	-
	2863	SU	-	SU	-	PU	Unk.	Unoccupied		Unoccupied		NR	-
	2864	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2865	PU	Unk.	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2889	P	0	P	0	P	F	P	Unk.	P	2	P	0
	2891	P	Unk.	P	N	P	Unk.	SU	-	Unoccupied		Unoccupied	
	2895	P	N	P	N	P	N	P	N	P	Unk.	Unoccupied	
	2897 [d]	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		SU	-
	2900	P	2	PU	Unk.	P	Unk.	P	Unk.	Unoccupied		SU	-
	2949	SU	-	SU	-	Unoccupied		SU	-	SU	-	SU	-
	3550	P	0	P	1	P	N	P	N	A	0	P	0
	Puma.	SU	-	Unoccupied		SU	-	SU	-	Unoccupied		Unoccupied	
	4105	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Not surveyed		Not surveyed	
	4392 [d]	A	2	SU	-	P	F	P	N	SU	-	SU	-

LSR	MSNO [c]	2003		2004		2005		2006		2007		2008	
		Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.
Fall Creek	4420 [d]	Unoccupied		PU	N	P	Unk.	P	Unk.	P	2	RM	-
	4421	P	N	P	0	P	0	P	N	P	1	P	1
	4549 [d]	PU	Unk.	Unoccupied		Unoccupied		P	N	SU	-	Unoccupied	
	4585 [d]	P	0	P	1	P	N	SU	-	SU	-	SU	-
Hagan	0112	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied		NR	-
	3401	P	0	P	N	RM	-	P	N	RM	-	Unoccupied	
	4503	P	F	P	F	RM	-	PU	Unk.	P	0	P	0
	5070	Unoccupied		SU	-	RF	Unk.	PU	Unk.	Unoccupied		Unoccupied	
	5071	Unoccupied		Unoccupied		SU	-	Unoccupied		Unoccupied		Unoccupied	
Horse Creek	0818	P	0	P	0	P	Unk.	SU	-	RM	-	RM	-
	0834	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	0750	P	Unk.	P	1	SU	-	P	Unk.	P	0	P	0
	UEF	Unoccupied		Unoccupied		RM	-	Unoccupied		Unoccupied		P	Unk.
	0857	PU	Unk.	SU	-	RF	Unk.	PU	Unk.	A	2	NR	-
	0119	P	N	P	1	RF	N	Unoccupied		Unoccupied		Unoccupied	
	1736	P	2	P	0	P	1	P	N	A	Unk.	PU	Unk.
	2831	PU	Unk.	P	0	RM	-	RM	-	P	0	P	Unk.
	2428	P	1	P	2	P	N	P	1	P	0	P	0
	2447 [d]	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2828	Unoccupied		SU	-	Unoccupied		Unoccupied		Unoccupied		SU	-
	3023	P	Unk.	P	1	P	N	P	Unk.	P	2	Unoccupied	
	0113	SU	-	RM	-	Unoccupied		Unoccupied		SU	-	Unoccupied	

LSR	MSNO [c]	2003 Occ.	2003 Repro.	2004 Occ.	2004 Repro.	2005 Occ.	2005 Repro.	2006 Occ.	2006 Repro.	2007 Occ.	2007 Repro.	2008 Occ.	2008 Repro.
S. Santiam	0011	P	N	P	2	P	N	P	1	PU	Unk.	Unoccupied	
	0014	P	0	SU	-	PU	Unk.	Unoccupied		Unoccupied		Unoccupied	
	0619	RM	-	SU	-	P	N	P	N	P	0	P	0
	0064	Unoccupied		Unoccupied		Unoccupied		RM	-	Unoccupied		Unoccupied	
	1156	Unoccupied		SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2460	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2956	P	0	PU	0	A	0	RM	-	P	2	P	0
	2959	Unoccupied		P	1	P	N	RM	-	P	0	P	1
	2962	P	N	P	1	P	Unk.	Unoccupied		Unoccupied		NR	-
	0694	Unoccupied		Unoccupied		Unoccupied		Unoccupied		P	0	RM	-
	4196	P	2	P	F	P	1	P	N	SU	-	SU	-
	4405	RF	-	P	1	P	Unk.	RM	-	P	1	SU	-
	4488	PU	Unk.	RM	-	P	Unk.	Unoccupied		Unoccupied		Unoccupied	
	0689	Unoccupied		Unoccupied		P	0	P	N	P	0	P	0
	1322	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2846	--		--		P	N	P	N	P	0	SU	-

[a] Occupancy status for each site was classified as: P = pair; A = pair plus one or more additional adults or subadults; RM = resident single male; RF = resident single female; PU = pair of owls detected only one of which meets the requirements for residency; SU = one or more owls detected but not meeting the above criteria and survey effort was at least three night visits; SD = one or more owls detected but not meeting the above criteria and survey effort was less than three night visits; NR = no responses in less than 3 night visits. Subscripts indicate that the species was a spotted owl when hybrids were also located at the site.

[b] Reproductive status for each site was classified as: 0, 1, 2, 3 = number of young produced; N = confirmed non-nesting; F = confirmed nest failure; Unk. = undetermined.

[c] Master Site Numbers in bold are new or corrected numbers. Please see Appendix 1 for the master site number revisions.

[d] Spotted/barred owl hybrid(s) identified at this site (see Appendix 5).
[e] This site (Saturn/Briem) had not been assigned an MSNO. The number previously used for this site was originally assigned to Briem Creek (see Appendix 1). A new site name (Saturn Creek) has been proposed that combines Saturn/Briem and Saturn/Platt; a new MSNO has been requested.
[f] The Logan (2858) and L. Logan (2899) sites are not distinct territories. They have been surveyed as a single site since 2000 and are now designated Logan Creek (2858) (see Appendix 1).
[g] This site (Pumarine) had not been assigned an MSNO. The number previously used for this site was 4082 (see Appendix 1).
[h] A spotted owl x barred owl pair produced two hybrid fledglings at this site.
[i] Two pairs of spotted owls were located at two different historic site centers at this site. A second site designation is proposed pending the assignment of a new MSNO (Buzzard Creek West).

Appendix 2. Summary of survey effort and site occupancy in the four late-successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 through 2008.

LSR	Year	Sites surveyed	Occupied [a] sites (%)	Sites occupied by pairs (%)
Fall Creek	1997	0	-	-
	1998	22	17 (77)	13 (59)
	1999	35	30 (86)	23 (66)
	2000	40	33 (83)	25 (63)
	2001	41	35 (85)	25 (61)
	2002	41	36 (88)	25 (61)
	2003	41	35 (85)	21 (51)
	2004	43	33 (77)	25 (58)
	2005	42	30 (71)	24 (57)
	2006	43	31 (72)	20 (47)
	2007	43	32 (74)	21 (49)
	2008	36	26 (75)	16 (44)
Hagan	1997	4	3 (75)	2 (50)
	1998	5	3 (60)	2 (40)
	1999	5	3 (60)	0
	2000	5	3 (60)	1 (20)
	2001	5	5 (100)	2 (40)
	2002	5	2 (40)	1 (20)
	2003	5	3 (60)	2 (20)
	2004	5	3 (60)	2 (20)
	2005	5	4 (80)	0 (0)
	2006	5	3 (60)	3 (60)
	2007	5	3 (60)	1 (20)
	2008	4	1 (25)	1 (25)
Horse Creek	1997	10	7 (70)	3 (30)
	1998	13	9 (69)	7 (54)
	1999	13	9 (69)	7 (54)

LSR	Year	Sites surveyed	Occupied [a] sites (%)	Sites occupied by pairs (%)
Horse Creek	2000	12	9 (75)	7 (58)
	2001	13	9 (69)	5 (38)
	2002	14	7 (50)	3 (21)
	2003	13	10 (77)	8 (21)
	2004	14	11 (79)	8 (57)
	2005	13	9 (64)	4 (29)
	2006	13	8 (62)	5 (38)
	2007	14	9 (64)	6 (43)
	2008	12	8 (67)	6 (50)
S. Santiam	1997	12	9 (75)	4 (33)
	1998	13	9 (69)	5 (38)
	1999	9	8 (89)	5 (56)
	2000	14	11 (79)	2 (14)
	2001	14	8 (57)	5 (36)
	2002	15	9 (60)	5 (33)
	2003	15	8 (53)	6 (40)
	2004	15	10 (67)	6 (40)
	2005	16	11 (69)	11 (69)
	2006	16	9 (56)	5 (31)
	2007	16	9 (56)	8 (50)
	2008	15	8 (53)	4 (27)

[a] Sites were considered occupied if they were surveyed at least three times at night with one or more responses that could not be attributed to any other site.

Appendix 3. Summary reproductive statistics in the four late-successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 through 2008.

LSR	Year	Nesting surveys [a]	Pairs nesting	Reproductive surveys [b]	Pairs fledging young (%)	Young fledged	Young per successful pair	Young per all pairs
Fall Creek	1997	Fall Creek not surveyed by OCFWRU staff in 1997.						
	1998	9	7	10	4 (40)	8	2.00	0.80
	1999	8	2	12	4 (33)	8	2.00	0.67
	2000	10	8	18	12 (67)	20	1.67	1.11
	2001	13	6	23	15 (65)	24	1.60	1.04
	2002	17	14	22	15 (71)	27	1.80	1.23
	2003	14	2	18	2 (11)	4	2.00	0.22
	2004	18	13	22	13 (59)	22	1.69	1.00
	2005	14	6	17	0	0	0	0
	2006	15	0	16	0	0	0	0
	2007	13	9	19	11 (58)	16	1.50	0.80
	2008	7	4	17	5 (29)	6	1.20	0.35
Hagan	1997	1	1	1	0	0	0	0
	1998	1	1	1	0	0	0	0
	1999	0	0	0	0	0	0	0
	2000	0	0	0	0	0	0	0
	2001	1	1	2	2 (100)	3	1.50	1.50
	2002	1	0	1	0	0	0	0
	2003	1	1	1	0	0	0	0
	2004	2	1	2	0	0	0	0
	2005	0	0	0	0	0	0	0
	2006	1	0	1	0	0	0	0
	2007	1	0	1	0	0	0	0
	2008	1	0	1	0	0	0	0
Horse Creek	1997	1	0	1	0	0	0	0
	1998	2	0	5	2 (40)	2	1.00	0.40
	1999	4	2	5	1 (20)	2	2.00	0.40
	2000	3	2	3	1 (33)	1	1.00	0.33
	2001	3	2	5	3 (60)	6	2.00	1.20

LSR	Year	Nesting surveys [a]	Pairs nesting	Reproductive surveys [b]	Pairs fledging young (%)	Young fledged	Young per successful pair	Young per all pairs
Horse Creek	2002	2	1	3	1 (33)	1	1.00	0.33
	2003	2	1	4	2 (50)	3	1.50	0.75
	2004	2	2	8	5 (63)	7	1.40	0.88
	2005	3	0	4	1 (25)	1	1	0.25
	2006	2	1	2	1 (50)	1	1	0.50
	2007	2	2	5	2 (40)	4	2	0.8
	2008	1	0	2	0	0	0	0
S. Santiam	1997	3	2	3	0	0	0.00	0.00
	1998	3	2	4	1 (25)	2	2.00	0.50
	1999	1	0	3	0	0	0.00	0.00
	2000	1	1	2	1 (50)	1	1.00	0.50
	2001	2	2	3	2 (67)	4	2.00	1.33
	2002	2	2	3	3 (100)	3	1.00	1.00
	2003	3	1	6	1 (17)	2	2.00	0.33
	2004	4	4	6	4 (67)	5	1.25	0.83
	2005	4	1	7	1 (14)	1	1.00	0.14
	2006	4	1	5	1 (20)	1	1	0.20
	2007	3	3	7	2 (29)	3	1.50	0.40
	2008	4	2	4	1 (25)	1	1.00	0.25

[a] Includes pairs and females given at least four mice on at least two occasions by 31 May and all females examined for a brood patch by 30 June.
[b] Includes all pairs and females given at least four mice on at least two occasions by 31 August.

Appendix 4. Summary of spotted/barred hybrid owl activity in the Central Cascades Study Area, Willamette National Forest, Oregon from 1999 through 2007.

Year	MSNO	Male species [a]	Female species	Number of young fledged	Additional STOC observations
1999	1015	STXX	STVA	1	Pair, reproduction unknown
2000	1015	STXX	STVA	Unknown	None
2001	1015	STXX	--	--	Female, 1 auditory detection
	4549	STOC	STVA	2	None
2002	1015	STXX [b]	STVA	2	None
	2446	STVA	STXX	Unknown	Male, 1 auditory detection
2003	1015	STXX [b]	--	--	None
	1013	--	STXX [c]	Unknown	Resident male
	1031	STXX	--	--	Male, 1 auditory detection
2004	1015	STXX	STVA	Unknown	Male, 1 auditory detection
	1031	STXX [d]	STVA	2 [e]	None
	2897	--	STXX [f]	Unknown	Male, 1 auditory detection
	2861	STXX	STVA	Unknown	Male, visual identification
	2447	--	STXX	Unknown	Pair, 1 auditory detection
	4392	STXX [g]	STVA	Unknown	Pair, 1 auditory detection
	4549	STXX	--	--	None
	1828 Rd	STOC	STXX [c]	Non-nesting	None
2005	1015	STXX	STVA	Unknown	Unk. sex, 1 auditory detection
	1031	STXX [h]	STVA	1 [i]	None
	2861	STXX	--	Unknown	Unk. sex, 1 auditory detection
	4392	STXX	--	Unknown	Pair, failed nesting attempt
2006	1012	STXX	--	Unknown	Male, visual, not identified
	1015	STXX	STVA	Unknown	None
	1016	STXX	--	Unknown	Male, visual identification
	1031	STXX [d]	STVA	2 [e]	None
	2410	--	STXX	Unknown	Pair, no young produced
	4420	STXX	--	Unknown	Pair, 1 auditory detection

Year	MSNO	Male species [a]	Female species	Number of young fledged	Additional STOC observations
2006	4585	STXX	--	Unknown	Female, 2 auditory detections
	1828 Rd.	STOC	STXX [c]	Non-nesting	None
2007	1013	STOC	STXX	0	None
	2413	--	STXX	0	Pair, non-nesting
	4392	STXX	--	Unknown	None
2008	1013	STOC	STXX [c]	0	Male, 1 auditory detection
	4392	STXX	--	Unknown	Male, 3 auditory detections

[a] STOC = northern spotted owl, STVA = barred owl, STXX = spotted/barred owl hybrid.
[b] Banded as an adult on 9 June 2002; orange/yellow tab, left leg.
[c] Banded 141 km SSW of the study area as a fledgling on 21 June 2001, color band replaced 30 April 2003: pink/white dots/orange tab, left leg. This owl was also re-sighted at site 2888 on 13 August 2003.
[d] Banded as an adult on 17 May 2004; green/white triangles, right leg.
[e] One F2 fledgling banded on 21 June 2004; white/red triangles, left leg.
[f] Banded as an adult on 26 May 2004; black/white dots/white tab, left leg.
[g] Banded 103 km SW of the study area as a 2-year-old on 11 March 2003, re-sighted on the study area on 19 May 2004; green/white diagonals/orange tab, left leg.
[h] Lost original color band. New band attached on 20 June 2005; pink/white dots/black tab, right leg.
[i] Single fledgling banded on 20 June 2005; red/white stripe, left leg.